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PATENT SPECIFICATION

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(54) APPARATUS FOR CONCENTRATING LABORATORY SPECIMENS BY EVAPORATION

(71) We, BRINKMANN INSTRUMENTS, INC., a corporation organised under the laws of the State of New York, United States of America, of Cantiague Road, Westbury, State of New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention is concerned with apparatus for concentrating chemical and biological specimens which occur in a highly diluted or attenuated form in an evaporatable medium.

Conventionally, laboratory specimens are concentrated by evaporating off the more volatile liquids or solvents by controlled heating of the specimen vials, often under fume hoods which exhaust to the atmosphere in order to prevent the accumulation of vapors in the laboratory. It is also known in the art to augment the evaporation process by the use of a partial vacuum. In such vacuum systems, localized boiling or spattering due, for example, to hot spots, can cause contamination of adjacent specimens by air-borne droplets. The efficiency of conventional evaporating devices is further limited by the presence of vapor layers above the liquid and by poor circulation of the liquid specimen within the vial during evaporation. A further difficulty encountered with conventional devices is solvent vapor contamination of the atmosphere either within the laboratory or, in the cases where fume hoods are used, in the outdoors. It is impractical in most cases to provide adequate filtering and condensing functions in the high volume exhaust fans normally used with fume hoods.

According to the present invention there is provided an apparatus for concentrating laboratory specimens by evaporation comprising a closed chamber including a plurality of separate supporting compartments fixed relative to the chamber for supporting open vessels for containing the laboratory specimens, which vessels are removable from the chamber, gas nozzle means to direct streams of gas downwardly onto respective specimen surfaces, removable closure means incorporating a gas intake manifold for effecting closure of the chamber, a gas outlet from the chamber and means to establish a gas pressure differential between the manifold and the chamber whereby when specimens are located in the chamber and when the gas pressure differential is established jet streams of gas flow through the nozzle means and are directed downwardly on the surface of the respective specimens.

In a preferred embodiment a battery of specimen vessels is mounted in a common heating source, such as a massive heat sink, temperature regulated by thermostatic means and formed with the plurality of compartments into which the vessels or vials are seated in close proximity with the metal walls. Preferably an air-tight chamber is provided above the specimens which is connected to a relatively low volume vacuum pump, preferably through a fume condenser for recovering solvents. Disposed above each of the specimen vials is an air nozzle capable of directing a jet stream of significant velocity directly downward onto the surface of the liquid. The nozzles are preferably connected as through a common manifold to an atmospheric vent so that, when the chamber immediately above the vials is placed under partial vacuum, a jet stream impinges down upon the liquid in the respective vials. The jet stream functions to break down the vapor layer which normally appears above warmed liquids, replacing it with dry air which augments the evaporation process. The dynamic effect of the jet is also felt by the liquid itself and results in a stirring action on the liquid setting up circulation patterns which eliminate localized hot spots in the vials and thus prevent bubbling which causes particles of liquid to become air-borne and hence capable of contaminating other specimens.

FIGURE 1 is a view in perspective of an

apparatus for evaporating thirty-six specimens simultaneously;

FIGURE 2 is an exploded fragmentary view in vertical section of the apparatus of FIGURE 1, taken on the line 2—2 looking in the direction of the arrows; and

FIGURE 3 is a view in vertical section of a portion of a specimen concentrating apparatus showing another embodiment of the invention.

The invention is illustrated as embodied in a specimen-evaporating apparatus including a housing assembly 10 for holding a plurality of specimens to be evaporated and connected to a vacuum pump 11, preferably through a fume condenser 12. The housing assembly 10, as best seen in FIGURE 2, includes a base portion 13 in which is mounted a metal specimen block 14 having a plurality of, say, thirty-six supporting compartments or chambers 14—1, 14—2...14—36. The block 14 is heated by electrical resistance heaters 15, and its temperature is sensed by an adjustable thermostat 16 which controls the circuit to the heaters 15.

The block 14 is also formed with slots 17 and 18 at its ends to receive depending legs 19 and 20 respectively of a rack 21 for holding the specimen vessels or vials 22—1, 22—2...22—36. The specimen vials are illustrated in the form of shouldered glass test tubes which rest in holes 23. The holes 23 correspond to the spacing of the heating chambers 14 and are brought into register therewith by the legs 19 and 20 fitting into the slots 17 and 18 of the block 14. In this fashion, the glass vials can be lowered into the heating chambers without bumping the block. The slot 17 and leg 19 are both narrower than the slot 18 and leg 20, thus assuring correct orientation.

The housing assembly 10 is completed by a cover assembly 24 which includes a depending peripheral skirt portion 25 adapted to seat on a sealing gasket 25*a* on the base 13. The cover assembly 24 is divided into upper and lower chambers 26 and 27 respectively by a transverse barrier plate 28 which includes thirty-six apertures 29—1, 29—2...29—36 adapted to be brought into alignment with the respective axes of the specimen vials 22—1, 22—2...22—36. Seated in the respective apertures are nozzle fittings 30—1, 30—2...30—36 in sealing relationship with the barrier plate 28, and each including a central bore 31 disposed vertically and connecting the upper and lower chambers 26 and 27.

The lower chamber 27 includes an evacuating fitting 32 adapted to be connected to the vacuum pump 11 and fume dispenser 12. The upper chamber 26 is vented to the atmosphere. With the system assembled with the specimen vials in place in their respective chambers and the cover assembly 24 seated in air-tight relationship on the base 13, evaporation of the specimens is commenced under the controlled heat of the block 14. With the vacuum pump in operation, air will flow from the atmosphere in the chamber 26 which serves as a manifold for all of the thirty-six nozzle fittings, with the result that an individual jet air stream will be directed downwardly into each of the specimen vials as a result of the sub-atmospheric pressure in the lower chamber which functions as an exhaust manifold. From this chamber both the vapors which arise from the specimens and the air which enters through the nozzle fittings will be exhausted to the atmosphere, preferably externally of the laboratory. The downwardly directed air jets would impinge dynamically on the liquid surfaces in each of the specimen vials and will perform the dual functions of gently stirring the liquid (and thus tending to prevent localized hot spots which might cause bubbling) and of blowing away or dispelling the vapors which continuously rise from the specimen liquid. With the evaporation action already augmented by the sub-atmospheric pressure in the chamber 27 and with the vapor layer being continuously dispelled, an accelerated evaporation rate occurs without the necessity of resorting to higher evaporating temperatures which might be harmful to the specimens or which might cause boiling or spattering which would cause particles of the specimens from rising into the chamber 27 to fall into other specimen vials to cause contamination.

Referring to FIGURE 3, there is illustrated a modification of the invention in which the cover assembly 24' includes nozzle tubes 33 (which can correspond in number to the number of rows of specimen vials) supported by the end walls of the cover assembly 24'. The nozzle tubes 33 are vented at their ends to the atmosphere and include at equally spaced points along their lengths radial bores 34—1, 34—2...34—36 directed downwardly to the respective specimen holders. In this modification, the entire inside chamber 35 of the cover assembly defines the exhaust manifold and the spaces within the nozzle tubes 33 define the intake manifold. With the chamber 35 placed under sub-atmospheric pressure, the system functions identically with that described above having reference to FIGURE 2.

WHAT WE CLAIM IS:—

1. An apparatus for concentrating laboratory specimens by evaporation comprising a closed chamber including a plurality of separate supporting compartments fixed relative to the chamber for

supporting open vessels for containing the laboratory specimens, which vessels are removable from the chamber, gas nozzle means to direct streams of gas downwardly onto respective specimen surfaces, removable closure means incorporating a gas intake manifold for effecting closure of the chamber, a gas outlet from the chamber and means to establish a gas pressure differential between the manifold and the chamber whereby when specimens are located in the chamber and when the gas pressure differential is established jet streams of gas flow through the nozzle means and are directed downwardly on the surface of the respective specimens.

2. An apparatus as claimed in claim 1 further comprising heating means for heating the specimens.

3. An apparatus as claimed in claim 1 or 2, wherein said means to establish a gas pressure differential comprises means to establish sub-atmospheric pressure in the chamber.

4. An apparatus as claimed in claim 3, wherein said means to establish sub-atmospheric pressure comprises vacuum pump means and, connected in series therewith, condensing means for liquids evaporated from the specimen vessels.

5. An apparatus as claimed in any of claims 1, 2, 3 or 4, wherein said closed chamber includes common means to impart heat to all of said vessels simultaneously.

6. An apparatus as claimed in claim 5, wherein the separate compartments are defined in a common rack for supporting said plurality of specimen vessels.

7. An apparatus as claimed in claim 5 or 6, wherein said manifold comprises a plate having a plurality of apertures therein aligned with respective compartments and a gas nozzle insert seated in each aperture.

8. An apparatus as claimed in any of claims 5 or 6, wherein said manifold is formed by a tubular member extending through the chamber and open to the atmosphere on at least one of its ends and having a plurality of gas nozzles formed in the wall thereof to direct gas jet streams downwardly to the specimens.

9. An apparatus substantially as hereinbefore described with reference to, and as illustrated in, the accompanying drawing.

For the Applicants:
MATTHEWS, HADDAN & CO.,
Chartered Patent Agents,
Haddan House
33 Elmfield Road,
Bromley, Kent BR1 1SU.

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1 SHEET This drawing is a reproduction of the Original on a reduced scale

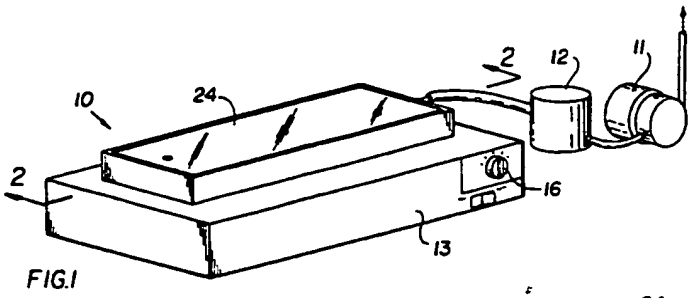

FIG.1

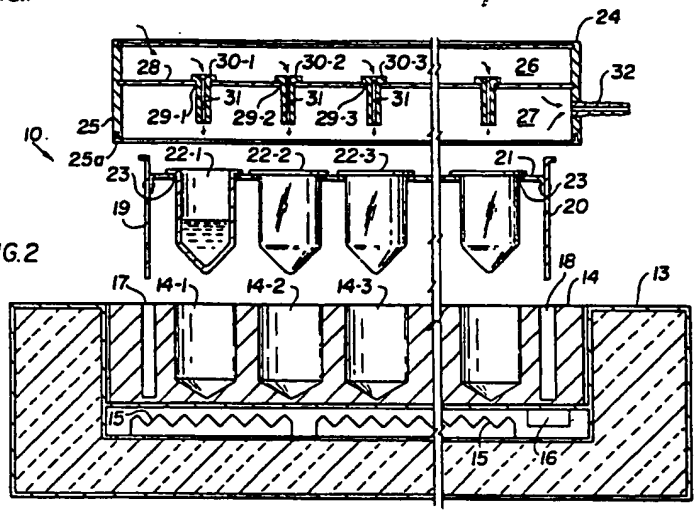

FIG.2

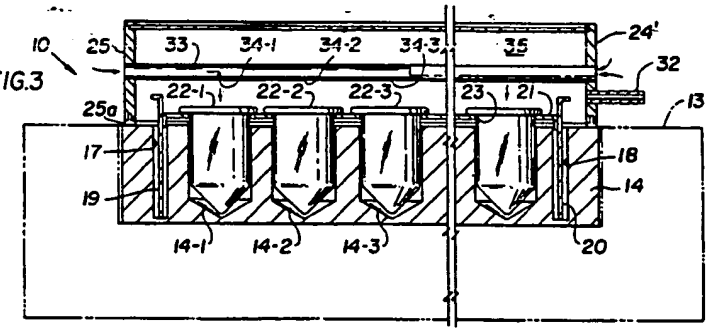

FIG.3